British Journal of Ophthalmology

Prevalence and Causes of Vision Loss in Latin America and the Caribbean: 2015: Magnitude, Temporal Trends, and Projections

Journal:	*British Journal of Ophthalmology*
Manuscript ID	Draft
Article Type:	Global issues
Date Submitted by the Author:	n/a
Complete List of Authors:	Leasher, Janet; Nova Southeastern University, HPD/College of Optometry Braithwaite, Tasanee; Moorfields Eye Hospital NHS Foundation Trust, Ophthalmology Furtado, Joao; Universidade de São Paulo , Flaxman, Seth; Imperial College London Lansingh, Van Charles; 6. Help Me See Latin America, Instituto Mexicano de Oftalmologia Silva, Juan Carlos; Pan American Health Organization, Regional Advisor for the Prevention of Blindness; Pan American Helath Organization , FGL Resnikoff, Serge; University of New South Wales, (7) Brien Holden Vision Institute & School of Optometry and Vision Science Taylor, Hugh; The University of Melbourne, Melbourne School of Population and Global Health Bourne, Rupert; Vision and Eye Research Unit (VERU), Postgraduate Medical Institute
Keywords:	Epidemiology, Public health, Vision

TITLE PAGE

TITLE: Prevalence and Causes of Vision Loss in Latin America and the Caribbean: 2015: Magnitude, Temporal Trends, and Projections.

AUTHORS: Janet L. Leasher (1), Tasanee Braithwaite (2), João M. Furtado (3), Seth R. Flaxman (4), Van Lansingh (5), Juan Carlos Silva (6), Serge Resnikoff** (7), Hugh R. Taylor**(8), Rupert R. A. Bourne** (9), on behalf of the Vision Loss Expert Group[§] of the Global Burden of Disease Study.

(1) College of Optometry, Nova Southeastern University, Fort Lauderdale, United States of America
(2) Moorfields Eye Hospital, London, United Kingdom
(3) Division of Ophthalmology, Ribeirão Preto Medical School, University of São Paulo, Ribeirão Preto, São Paulo, Brazil
(4) Imperial College London, London, United Kingdom
(5) HelpMeSee, Inc., New York, United States of America; Instituto Mexicano de Oftalmología, Querétaro, Mexico
(6) Pan American Health Organization, Bogotá, Colombia
(7) Brien Holden Vision Institute & School of Optometry and Vision Science, University of New South Wales, Sydney, Australia
(8) Melbourne School of Population and Global Health, University of Melbourne, Australia
(9) Vision & Eye Research Unit, Anglia Ruskin University, Cambridge, United Kingdom

**Serge Resnikoff, Hugh Taylor, and Rupert Bourne share the senior authorship

[§]Group Information: A list of the Vision Loss Expert Group members appears at http://www.anglia.ac.uk/epidemiology%20/

RUNNING TITLE: 2015 Vision Loss in Latin America and Caribbean (LAC)

CORRESPONDING AUTHOR: Rupert R. A. Bourne. Address: Vision and Eye Research Unit, Postgraduate Medical Institute, Anglia Ruskin University, East Road, Cambridge, CB1 1PT, United Kingdom. Email: rb@rupertbourne.co.uk

ACKNOWLEDGMENTS: The authors extend special recognition to those researchers who participated in the data extraction process and contributed unpublished micro-data for this study and to members of the Vision Loss Expert Group who were regional coordinators and formed part of the original core team for their conceptual vision and coordinated global effort.

COMPETING INTERESTS: There are no competing interests.

DISCLAIMER STATEMENT: While the work that is reported here was performed by the Vision Loss Expert Group as part of the Global Burden of Disease, Risk Factors and Injuries Study 2015, the results prepared here by the authors in this paper are prepared independently of the final estimates of the Global Burden of Disease 2015.

FUNDING: This study was partially funded by the Brien Holden Vision Institute. The results in this paper are prepared independently of the final estimates of the Global Burden of Diseases, Injuries, and Risk Factors study. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

CONTRIBUTORSHIP STATEMENT: 1) substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data: JL, TB, SRF, JF, VL, JCS, SR, HRT, RRAB; 2.) Statistical analysis: SRF; 3) drafting the article or revising it critically for important intellectual content: JL, TB, JF, VL, JCS, SR, HRT, RRAB; and 4) final approval of the version to be published: JL, VL, JF, TB, JCS, SRF, SR, HRT, RRAB

ABSTRACT

OBJECTIVE

To estimate the prevalence and causes of blindness and vision impairment for distance and near in Latin America and the Caribbean (LAC) in 2015, and to forecast trends to 2020.

METHODS

A meta-analysis from a global systematic review of cross-sectional, population-representative studies from published and unpublished sources from 1980 to 2014 included in the Global Vision Database.

RESULTS

In 2015, across LAC, we estimate age-standardised prevalence to be 0.38% in all ages and 1.56% in those over age 50 for blindness, 2.06% in all ages and 7.86% in those over age 50 for moderate and severe vision impairment (MSVI), 1.89% in all ages and 6.93% in those over age 50 for mild vision impairment, and 39.59% in all ages and 45.27% in those over 50 for near vision impairment. We estimate that in 2015, 123.26 million persons were vision impaired; of those 2.34 million blind, 12.46 million with MSVI, 11.34 million mildly impaired and 97.12 million had near vision impairment. Cataract is the most common cause of blindness. Under-corrected refractive-error is the most common cause of vision impairment.

CONCLUSIONS

Increasing granularity in prevalence estimates across all levels of vision loss suggest that one in five persons across LAC had some degree of vision loss in 2015. The absolute numbers of persons with vision impairment are increasing, while the age-standardised prevalence is decreasing. All countries should conduct epidemiologic studies to establish accurate national estimates and trends of vision impairment. Universal eye health services must be included in universal health coverage reforms to address fragmentation and segmentation of health care across the region.

KEYWORDS– prevalence, blindness, vision impairment, Latin America and Caribbean

INTRODUCTION

The countries in Latin America and the Caribbean (LAC) global region have witnessed transformational health system reforms in moving toward universal health care since the 1980s and 1990s.[1, 2] However, not all countries have transitioned to the same extent. Health systems across the Americas are segmented by a mix of traditional public sector services for the poor, social security services for formal employees and their families, and private services for those who can afford it. The rights granted, the coverage and the institutional organization and quality vary for different population groups, leading to fragmentation of care. Both fragmentation and segmentation of health systems constitute important barriers to expanding coverage, achieving integrated primary health care, and reducing inefficiency and discontinuity of care.[3] A study within Bogotá, Colombia, revealed a direct association between accessibility to health services and health status.[4]

Visual and eye health status bear the consequences of this segmentation and fragmentation. We reported that in 2010, for every 100 persons in Latin America and Caribbean countries aged 50 years and older, there were approximately 10 with moderate and severe vision impairment (visual acuity of <6/18 to ≥3/60), and two who were blind (visual acuity <3/60).[5] The age-standardized prevalence of blindness had halved from 0.8% to 0.4% between 1990 and 2010.[5] There was a reduction in vision loss resulting from cataract, which may reflect increased regional provision of cataract surgeries.[6] Rising causes of vision loss included uncorrected refractive error, diabetic retinopathy, glaucoma and macular degeneration.[5] We acknowledged the successful reduction of neglected tropical diseases in the region including onchocerciasis and trachoma.[5] We expressed concern that the absolute numbers of persons blind or vision impaired may be rising due to ageing population demographics.[5] As an example, the percentage of individuals aged 65 and above living in Latin America and the Caribbean rose from 4.75% in 1990 to 7.59% in 2015.[7]

The demand for a reduction of blindness globally launched the 'VISION 2020: The Right to Sight' campaign in 1999 by the World Health Organization (WHO) and the International Agency for

the Prevention of Blindness (IAPB). This initiative challenged countries to eliminate avoidable blindness by the year 2020.[8] In Latin America and the Caribbean, since 2004, the initiative has been driven as a partnership between the Pan American Health Organization (PAHO, representing WHO in the region), the IAPB, the Pan American Association of Ophthalmology representing local ophthalmological societies, and other non-governmental organizations. Building upon successes in the region, in 2014 the PAHO approved the Global Plan of Action for the Prevention of Blindness and Visual Impairment for 2014-2019.[9, 10] This plan outlined steps to improve eye health of populations, including collecting epidemiological data, increasing coverage of high-quality eye care services, and minimizing barriers. The plan aims to further reduce the prevalence of avoidable vision impairment globally in 2019 by 25%, as compared to the 2010 baseline.

The call to consistently apply globally comparable methodologies across and within regions to monitor the epidemiologic trends in blindness and vision impairment underpins the on-going work of the Vision Loss Expert Group within the Global Burden of Disease research group in the creation, analysis, and maintenance of a Global Vision Database (http://www.globalvisiondata.org/).[11, 12, 13, 14, 15] Our 2010 study identified a paucity of population-based surveys, and of nationally representative surveys, in Latin America and the Caribbean region prior to 2010.[5, 13]

The present report adds estimates for mild (visual acuity of <6/12 to ≥6/17) vision impairment and near vision impairment, and updates the previously published findings,[5] to estimate the prevalence and causes of vision loss in Latin America and the Caribbean for 2015, five years before the target date of the VISION 2020 Initiative, with projection to 2020. Projections will be important as the world moves toward the 2030 Agenda for Sustainable Development. The 17 Sustainable Development Goals and 169 targets include issues that are related to eye and vision health, such as universal health care, poverty reduction, economic stability and decent work, gender equality and inclusive society.[16]

METHODS

Consistent methodology to compare vision loss in regions and countries over time, gender and cause is the hallmark of outputs from the Global Vision Database (GVD).

In accordance with the methodology utilized for the 2010 series estimating vision loss at the global, regional and country level,[13] the present regional report for LAC utilises an identical methodology following the PRISMA guidelines as the global all-cause [14] and cause-specific[15] estimates for 2015, which have been published in full elsewhere.[14, 15]

In brief, we estimated 1990-2015 trends in vision impairment prevalence and their uncertainties, by age and gender, for 188 countries in the 21 Global Burden of Disease (GBD) regions using data in the Global Vision Database.[14] The Latin America and Caribbean super-region consists of five GBD regions: Caribbean, and Andean, Central, Southern and Tropical Latin America. The distribution of countries within these regions is presented in Table 1.

Using definitions and an analytical framework developed and first described by Stevens et al,[13] we estimated the prevalence of two core categories of vision impairment: blindness (presenting visual acuity worse than 3/60) and combined moderate and severe vision impairment (MSVI) (presenting visual acuity worse than 6/18 but better than or equal to 3/60). We included distance vision impairment data from population-based studies identified through a systematic review using previously published search terms,[11] including studies published between 1980 and July 2014 and unpublished data identified by members of the Vision Loss Expert Group.

We fitted two hierarchical Bayesian logistic regressions to estimate vision impairment prevalence over time - by age group, gender and country: one model for the prevalence of blindness and one model for the prevalence of MSVI. Using fully Bayesian statistical inference,[17] our posterior estimates of vision impairment were able to flexibly borrow strength, such that country-specific estimates were informed by study data from the same country, where available, and also by study data from other countries in the same region or the same year. We modeled hierarchical linear trends over time, allowing for region-specific trends in prevalence

of vision impairment from world regions. Prevalence estimates are reported as posterior means along with 80% posterior uncertainty intervals (UI).

We applied our model to forecast prevalence of blindness and MSVI into the future. Our model relies on health status and education as covariates. Since it is impossible to predict how these will evolve decades into the future, we extrapolated these covariates to the year 2020 and then held them constant to 2050. As our model gives estimates of crude prevalence for country-years, we relied on the United Nations Population Division's (UNPOP) forecasts to 2050 to derive crude numbers affected and age-standardized prevalence.[18]

We estimated the causal proportions of overall vision impairment attributable to cataract, glaucoma, age-related macular degeneration, diabetic retinopathy, corneal opacity, trachoma, uncorrected refractive error, and non-cause specific/other causes in 1990–2015, by geographical region and year.[15] We derived estimates of refractive error from the vision prevalence model described above, in which we explicitly modeled the contribution of refractive error to vision loss.

To model each of the other causes, we separately fit Bayesian hierarchical logistic regression models, with covariates as follows: age group indicator, sex indicator, a linear year term, an indicator for best-corrected vs. presenting visual acuity, an indicator for blind vs. MSVI, an indicator for nationally representative data, an indicator for urban vs rural, and a health access covariate, which was also used for the prevalence data. Each observation in the model was at the level of a particular age group within a study. We included super region and study-level random effects.

Each of our statistical models was fit with fully Bayesian inference through Markov Chain Monte Carlo sampling implemented in the probabilistic programming language Stan R.[19] In order to combine the separate causal estimates, we used the overall prevalence estimates at the region level by year as an envelope. We used the refractive error estimates as derived from this model, and then apportioned the remaining prevalence to the various causes, normalizing so that these causes fit within the envelope.

RESULTS

In the LAC combined region, we present model-based, age-standardized prevalence estimates by sex and geographic subregion within LAC, for all-ages and for adults 50 years and older.

The global analysis included 283 studies,[14] of which 23 studies (8.1%) were in the LAC region, representing 16 of 34 (47.1%) LAC countries (See Table 1). These included 17 (73.9%) published studies, and 6 unpublished data sets using the standardised Rapid Assessment of Avoidable Blindness or Cataract Surgery (RAAB/RAACS) protocol. Seven (30.4%) of the studies from the LAC region were nationally-representative, 3 (13.0%) were regionally-representative and 11 (47.8 %) were locally-representative. These studies were undertaken between the years of 1988 and 2014, and two, from Central Latin America, were newly added since the previous report.[5] The majority of studies (n = 19, 82.6%) used the RAAB/RAACS protocol and included the population aged 50 years and above. The remaining studies included those aged 40 years and above (n = 1), 60 years and above (n = 1), all ages (n = 1), and school-aged children (n = 1). The sample size of the included studies ranged from 801 to 5284, with a mean of 3477 (SD 1024) people. All 23 studies measured distance visual acuity, with 21 reporting both presenting and best-corrected acuity. Incidence data were available for studies in Barbados[20] and Peru.

In 2015 in the LAC region, the age-standardized prevalence of blindness in those over 50 years was 1.77 % and 0.43 % (80% UI 0.15-0.81) for all ages (Table 2). In 2015 the prevalence of blindness in those over 50 years was slightly higher in women, at 1.82 % (80% UI 0.69-3.23), than men, at 1.70 % (80% UI 0.63-3.01). The 2015 prevalence of MSVI was 2.78 % (80% UI 0.71-5.60) in all ages, and 10.37 % (80% UI 2.94-20.48) in those over 50 years.

The prevalence of mild distance vision impairment and presenting near vision impairment (presbyopia) by gender and age group for the regional level are herein estimated for the first time (Table 2). The prevalence of mild vision impairment was 2.37 % (80 %UI 0.55-4.93) in all

ages, and 8.13 % (80% UI 2.07-16.51) in those aged 50 years and above. The prevalence of presenting near vision impairment in 2015 in adults over 50 years was 45.27 % (80% UI 3.41–93.38).

Within the LAC region, the age-standardized prevalence of all categories of blindness and vision impairment was highest in the Latin American Andean region (Bolivia, Ecuador and Peru) with 4.32 % (80% UI 1.26-8.4) MSVI in all ages, and lowest in the Latin American Tropical (Brazil and Paraguay) and Southern (Argentina, Chile and Uruguay) regions, with 2.21 % (80% UI 0.50-4.67) and 2.71 % (80% UI 0.70 – 5.47), respectively (Table 3). In adults over 50 years, the age-standardized prevalence of blindness for both sexes was greatest in Guatemala and lowest in Argentina (Figure 1). The age-standardized prevalence of MSVI in those over 50 years was lowest in Brazil and highest in Haiti (Figure 2). Compared to the global mean prevalence estimate for blindness in those aged over 50 years, of 1.87 % (80% UI 0.67 - 3.39), the prevalence was estimated to be higher in the Caribbean and in Andean Latin America, but lower elsewhere in LAC. The prevalence of MSVI and mild vision impairment in those over 50 years was generally lower in LAC regions than the global average, with the exception of Andean Latin America, where it was higher. The same regional variation compared to the global mean was observed in the data by region for all ages (Table 3).

In 2015 the total number of blind persons in the LAC region was estimated to be 2.34 million, ranging from 0.22 million in the Caribbean to 0.96 million in Central Latin America. This represents 6.4% of the total number of blind people globally (Table 4). The total number of moderate and severe vision impaired persons in the LAC region was estimated at 12.46 million, ranging from 0.90 million in the Caribbean to 4.84 million in Central Latin America, which represents 5.7% of the total number globally. The total number of persons with mild vision impairment was estimated at 11.34 million, ranging from 0.80 million in the Caribbean to 4.37 million in Central Latin America, representing 6.0% of those globally. The total number of persons with near vision impairment in LAC was estimated at 91.72 million, ranging from 3.28 million in Southern Latin America to 36.97 million in Central Latin America, representing 8.4% of

those globally (see Table 4). Summing these for 2015 resulted in an estimated 123.26 million persons in LAC living with some degree of vision loss. This translates to approximately one in five persons in the region. These numbers are projected to increase to a small extent for each category of vision loss by 2020 (Table 4).

The Proportion of blindness, and vision impairment (MSVI) by cause in 2015 for all ages is shown in Table 5.

Cataract continues to cause the largest proportion of blindness in 2015 across all LAC regions, varying from 21.8% (80% UI 13.89-30.16) in Southern Latin America to 25.73% (80% UI 18.66-32.95) in the Caribbean. In every region except Southern Latin America, the second most frequent cause of blindness was under-corrected refractive error (UCRE), followed by glaucoma, then macular degeneration, then corneal opacity, and diabetic retinopathy was the sixth most common cause. In Southern Latin America, however, after cataract (21%, 80% UI 13.89-30.16), the subsequent most frequent causes of blindness were macular degeneration (14.34%, 80% UI 3.98-28.6) followed by glaucoma (13.34%, 80% UI 4.67-25.0), UCRE (13%, 80% UI 11.27-14.71), diabetic retinopathy (3.51%, 80% UI 0.51-8.08) and then corneal opacity (2.41%, 80% UI 0.19-5.85). While the global figures apportion 24.92% to other causes, LAC attributes between 31.45% (Southern Latin America) and 44.66% (Andean Latin America) to other causes, suggesting that the leading causes of blindness determined by surveys are becoming more diverse.

Nearly half (Andean 46.07% to Tropical 49.26%) of all MSVI can be attributed to under-corrected refractive error, making this a priority for intervention in LAC. Cataract is the second most common cause (Tropical 15.27% to 20.23% Andean) in all regions. Exceptionally, Southern Latin America had a very high proportion of macular degeneration (10.11%, 80% UI 2.78-20.18) in third place, almost four times higher than Andean Latin America (2.44%, 80% UI 0.47-5.27). The remaining causes of MSVI varied in proportion from region to region with regard to glaucoma vs. AMD, and DR was usually the fifth most common cause followed by

corneal opacity. These rankings are projected to change very little in 2020 even though the exact proportions might shift slightly.

DISCUSSION

The primary objective of this study was to present regional estimates of the prevalence and causes of blindness and vision impairment for distance and near in Latin America and the Caribbean (LAC) in 2015, with a secondary objective to model projected trends to 2020. To accomplish this, we undertook a systematic review of cross-sectional, population-representative studies from published and unpublished sources, and extracted data for meta-analysis.

This analysis had a number of limitations. Firstly, the number, type and frequency of studies available for inclusion in the LAC model deserves analysis. The systematic review identified population-representative surveys from 13 out of 17 (76%) countries in Latin America, but only 3 out of 17 (18%) countries in the Caribbean. The majority of surveys (78%) in the LAC region were based on the rapid assessment of avoidable blindness (RAAB) protocol. Limitations of this survey protocol include age restriction to those over 50 years, and those available at the time of screening, and cause attribution sometimes based on non-dilated examination with a direct ophthalmoscope, which may introduce diagnostic bias in cause attribution favoring cataract over posterior segment disease. Near vision impairment is not yet included in this protocol, and only recently was mild vision impairment included. The majority of surveys in the LAC region (70%) were not nationally representative. Potential bias could arise if there is regional variation within countries in the prevalence of blindness and vision impairment. 74% of the included studies were published, with a detailed outline of survey methodology available for scrutiny. Additional data from unpublished RAAB studies utilising standardised methodology was included, aiming to increase the power and representativeness of the model estimates. The

end-date for the search was July 2014, and we acknowledge that other studies will have been published since, which will be added to subsequent updates from the Global Vision Database.

This review has identified a particular need for epidemiological surveys in every country in the Caribbean region, and in Latin America in particular, in Colombia, Costa Rica, Nicaragua and Bolivia. In addition, new nationally representative studies are needed in countries whose data were obtained over 10 years ago, in order to update and facilitate more reliable temporal trend analysis. Future surveys should include measurement of mild and near vision impairment, as the latter has been recognised to have a significant economic and quality of life impact, at both individual and societal levels.[21] Furthermore, there was a marked paucity of data from younger age groups, with only 2 studies including people under 40 years. This problem is not specific to studies from the LAC region, and relates to challenges designing surveys of blindness in children and young people, for whom much larger sample sizes are required, along with specialised expertise and equipment, available to few surveys.

Overall, the LAC regional and country estimates for the age-standardized prevalence of blindness, mild vision impairment, MSVI and presbyopia have progressively become more described for the time period between 1990 and 2015. This may be the result of well-planned and well-executed programs and research conducted through WHO VISION 2020 and local Ministries of Health, and academic or other institutions. It is important to consider that with the increasing size and age of the population, the absolute numbers with vision loss in the region are substantial, with non-blinding vision impairment increasing. While we previously estimated that the prevalence of blindness had halved from 1990 to 2010,[5] our projections to 2020 predict only a slight reduction in the prevalence of avoidable blindness from 2015, implying that the region may fall short of the PAHO and WHO goal of a 25% reduction in avoidable blindness by 2020. Efforts could be intensified during the 2014-2019 action plan years to achieve this goal. Due to the aging population, the absolute number of people with vision loss continues to be a major public health concern in LAC.

The causes of vision loss in LAC are diversifying, with important causes falling under our largest category of 'other'. The proportion of the category of 'other' causes across LAC regions averaged approximately double that of the global proportion of 'other' causes in 2015. It is imperative to explore and document the prevalence of these other causes in order to consider the interventions necessary to address them.[22] Even with the most common cause of blindness, cataract, interventions such as cataract surgery have variable coverage and variable vision outcomes, which may be exacerbated by fragmented health care systems and more limited access to eye care in rural areas.[23] There is variability in whether the service is provided in the public hospital, by a private physician, a non-governmental organization or a visiting surgeon as well as variability in output and cataract surgical coverage rates. Costs borne by the patient range from zero to the full market price, and there are multiple barriers to accessing care. For example, higher levels of wealth, literacy and schooling have been associated with successfully obtaining cataract surgery, and improved surgical outcome.[24] In common with the wider health services in low, middle, and even high-income countries, eye care services are constrained by shortages and unequal distribution of appropriately qualified staff and specialised equipment, weak systems for planning and management, and bureaucracy.[24, 25]

Refractive error and cataract are considered treatable causes of vision impairment and may be considered avoidable. Together in 2015 they comprised approximately 36% of all cases of blindness, but 65.5% of all cases of MSVI in the region. By 2020 the proportion of cases of vision impairment caused by cataract and refractive error is projected to decrease another 2%. Hence, there is a need for further effort to reduce cataract-related blindness. The recognition of the importance of near vision impairment, and under-corrected distance refractive error encompassing a larger proportion of vision loss indicates the need for increased attention on refractive error correction. If refractive error can be properly addressed by the year 2020, further major advances in the reduction of vision impairment could be gained.

In contrast to the previous prevalence estimates presented in the 2010 study, which reported 95% confidence intervals,[5] this study presents 80% uncertainty intervals. We believe these Bayesian summaries of posterior distribution give a more accurate description of our posterior uncertainty than the more commonly used 95% confidence interval. An important limitation of this meta-analysis, reflected in the wide uncertainty intervals for the prevalence estimates, is the paucity of data from some sub-regions, and particularly the lack of nationally-representative data from countries within the LAC region, as reflected in Table 1. This resulted in the use of covariates for the super-region, which may explain why, in some GBD regions, the cause proportions estimated differ from the actual local or sub-national survey published reports.[24] As described in the introduction,[3] the fragmentation and segmentation of eye health systems between and within countries may explain why the use of super-region estimates may not necessarily reflect actual prevalence in a specific country or sub-national locale. All member states within the LAC region have signed up to the regional and global action plans and strategies advocated by the PAHO and WHO, which aim to reduce the burden of avoidable blindness and vision impairment. However, there has been less than expected progress in terms of the collection of epidemiological data since our last study reported data up to 2010. There was a particular lack of data on near vision impairment, reflected in the very wide uncertainty intervals, and it was not possible to disaggregate by severity of near vision impairment. Countries may need further encouragement with respect to the importance of both collecting epidemiological data, and reporting it in a timely fashion.

Future studies should examine specific coverage of eye and vision services within the health systems by each country in LAC, and also examine which specific factors are used to monitor and to evaluate eye care programs in different geographic areas and countries. This may be especially useful in the Latin American Andean region, Central region and the Caribbean, which differ markedly in terms of prevalence estimates, from Southern Latin America. Disparities may be indicative of fragmented health and eye care systems, but further investigation should uncover possible causes and more importantly indicate solutions for these differences. Furthermore, continual, accurate and comprehensive data are needed to evaluate

and eliminate disparities in the region. The increasing numbers of older persons, coupled with the increase in vision loss associated with older age, will require further intervention if continued reduction in both prevalence and absolute numbers of blind persons are to be seen in the LAC region and globally.

REFERENCES

1. Titelman D, Cetrangolo O, Acosta OL. Universal health coverage in Latin American countries: how to improve solidarity-based schemes. *Lancet* 2015;385(9975):1359-63.
2. Atun R, de Andrade LO, Almeida G, et al. Health-system reform and universal health coverage in Latin America. *Lancet* 2015;385(9974):1230-47.
3. Dal Poz MR, Sepulveda HR, Costa Couto MH, et al. Assessment of human resources for health programme implementation in 15 Latin American and Caribbean countries. *Hum Resour Health* 2015;13:24.
4. Mosquera PA, Hernandez J, Vega R, et. al.. Performance evaluation of the essential dimensions of the primary health care services in six localities of Bogota-Colombia: a cross-sectional study. *BMC Health Serv Res* 2013;13:315.
5. Leasher JL, Lansingh V, Flaxman SR, et al. Prevalence and causes of vision loss in Latin America and the Caribbean: 1990-2010. *Br J Ophthalmol* 2014;98(5):619-28.
6. Lansingh VC, Resnikoff S, Tingley-Kelley K, et al. Cataract surgery rates in Latin America: a four-year longitudinal study of 19 countries. *Ophthalmic Epidemiol* 2010;17(2):75-81.
7. The World Bank: Data. Population ages 65 and above (% of total) 1960-2015, Latin America & Caribbean.Website ©2017 The World Bank Group. Available from: https://data.worldbank.org/indicator/SP.POP.65UP.TO.ZS?locations=ZJ Accessed November 27, 2017.
8. Ackland P. The accomplishments of the global initiative VISION 2020: The Right to Sight and the focus for the next 8 years of the campaign. *Indian J Ophthalmol* 2012;60(5):380-6.
9. PAHO. Pan American Health Organization. Plan of Action for the Prevention of Blindness and Visual Impairment. Proceedings of the 53rd Directing Council of PAHO, 66th Session of the Regional Committee of WHO for the Americas, 29 September - 3 October 2014. *Document DC53/11*. Washington, USA: PAHO, 2014.
10. WHO. World Health Organisation Universal eye health: a global action plan 2014-2019. Geneva, Switzerland, 2013. Available from: http://www.who.int/blindness/AP2014_19_English.pdf?ua=1
11. Bourne R, Price H, Taylor H, et al. New systematic review methodology for visual impairment and blindness for the 2010 global burden of disease study. *Ophthalmic Epidemiol* 2013;20(1):33-9.
12. Bourne RR, Stevens GA, White RA, et al. Causes of vision loss worldwide, 1990-2010: a systematic analysis. *The LancetGlob Health* 2013;1(6):e339-49.
13. Stevens GA, White RA, Flaxman SR, et al. Global prevalence of vision impairment and blindness: magnitude and temporal trends, 1990-2010. *Ophthalmology* 2013;120(12):2377-84.
14. Bourne RRA, Flaxman SR, Braithwaite T, et. al. Magnitude, temporal trends and projections of the global prevalence of blindness and distance and near vision impairment: a systematic review and meta-analysis. *Lancet Glob Health*. 2017; 5(9): e888–e897.

15. Flaxman SR, Bourne RB, Resnikoff S, et. al. Global causes of blindness and distance vision impairment1990–2020: a systematic review and meta-analysis. *Lancet Glob Health*. December 2017;(5)12: e1221–e1234..
16. United Nations. Transforming our World: the 2030 Agenda for Sustainable Development. Resolution adopted by the General Assembly on 25 September 2015 (Document A70. L1). New York: United Nations, 2015.
17. Gelman A, Carlin JB, Stern HS, et. al. Bayesian Data Analysis, Third Edition. Chapman & Hall, editors, CRC Press. London: CRC Press, 2013.
18. United Nations, Department of Economic and Social Affairs, Population Division (2015). World Population Prospects: The 2015 Revision, Key Findings and Advance Tables. ESA/P/WP/241. Available from: https://esa.un.org/unpd/wpp/Publications/Files/Key_Findings_WPP_2015.pdf Accessed on November 28, 2017.
19. Stan Development Team. 2016. RStanArm: Bayesian applied regression modeling via Stan. R package version 2.11.1. http://mc-stan.org . [computer program]. http://mc-stan.org/, 2016.
20. Leske MC, Wu SY, Hyman L, et. al. Four-year incidence of visual impairment: Barbados Incidence Study of Eye Diseases. *Ophthalmology* 2004;111(1):118-24.
21. Frick KD, Joy SM, Wilson DA, Naidoo KS, Holden BA. The Global Burden of Potential Productivity Loss from Uncorrected Presbyopia. *Ophthalmology* 2015; 122(8):1706-10.
22. Furtado JM, Lansingh VC, Carter MJ, et al. Causes of blindness and visual impairment in Latin America. *Surv Ophthalmol.* 2012;57(2):149–77.
23. Batlle JF, Lansingh VC, Silva JC, et. al. The cataract situation in Latin America: barriers to cataract surgery. *Am J Ophthalmol* 2014;158(2):242-50 e1.
24. Silva JC, Mujica OJ, Vega E, et al. A comparative assessment of avoidable blindness and visual impairment in seven Latin American countries: prevalence, coverage, and inequality. *Rev Panam Salud Publica* 2015;37(1):13-20.
25. Mills A. Health care systems in low- and middle-income countries. *N Engl J Med* 2014;370(6):552-7.

TABLES AND FIGURES:

TABLE 1: Countries in Latin America and the Caribbean by Global Burden of Disease region

TABLE 2: Age-standardized prevalence of blindness and vision impairment by sex for those aged 50 and older and all ages in Latin America and the Caribbean in 2015 and projected to 2020

TABLE 3: Age-standardized prevalence of blindness and vision impairment (and 80% uncertainty interval) by sex and region comparing adults 50 years and older with all ages in 2015

TABLE 4: Absolute numbers of persons affected by blindness and vision impairment in Latin American and the Caribbean in 2015 and projections to 2020

TABLE 5: Proportion of blindness, and vision impairment (MSVI) by cause in 1990, 2010, 2015 and projected to 2020 for all ages (80% uncertainty interval)

FIGURE 1: Ladder plot showing the age-standardised prevalence of blindness in women (A) and men (B) aged 50+ years for 2015 by country

FIGURE 2: Ladder plot showing the age-standardised prevalence of moderate/severe vision impairment (MSVI) in women (A) and men (B) aged 50+ years for 2015 by country

TABLE 1: Countries in Latin America and the Caribbean by region

Region	Countries
Caribbean	Antigua and Barbuda, Bahamas, Barbados*, Belize, Bermuda, Cuba*, Dominica, Dominican Republic*, Grenada, Guyana, Haiti, Jamaica, Puerto Rico, Saint Lucia, Saint Vincent and the Grenadines, Suriname, Trinidad and Tobago
Latin America, Andean	Bolivia, Ecuador*, Peru*
Latin America, Central	Colombia, Costa Rica, El Salvador*, Guatemala*, Honduras*, Mexico*, Nicaragua, Panama*, Venezuela*
Latin America, Southern	Argentina*, Chile*, Uruguay*
Latin America, Tropical	Brazil* and Paraguay*

*Those for which data were available are marked with an asterisk.

A list of all references used for this analysis can be found in a web appendix at http://www.anglia.ac.uk/verugbd.

TABLE 2: Age-standardised prevalence of blindness and vision impairment by sex for those aged 50 and older and all ages in Latin America and the Caribbean in 2015 and projected to 2020

	2015	OVER 50	ALL AGES	2020	OVER 50	ALL AGES
Vision Impairment Category	**Sex**	**Mean (80% UI)**	**Mean (80% UI)**	**Sex**	**Mean (80% UI)**	**Mean (80% UI)**
Blindness						
	Male	1.55 (0.56 - 2.77)	0.38 (0.14 - 0.68)	Male	1.34 (0.46 - 2.45)	0.33 (0.11 - 0.60)
	Female	1.58 (0.56 - 2.84)	0.39 (0.14 - 0.70)	Female	1.36 (0.46 - 2.51)	0.33 (0.11 - 0.61)
	Both	1.56 (0.56 - 2.81)	0.38 (0.14 - 0.69)	Both	1.35 (0.46 - 2.48)	0.33 (0.11 - 0.61)
Moderate + Severe (MSVI)						
	Male	7.75 (3.31 - 13.21)	2.04 (0.85 - 3.50)	Male	7.10 (2.82 - 12.35)	1.86 (0.72 - 3.27)
	Female	7.96 (3.30 - 13.66)	2.09 (0.84 - 3.62)	Female	7.27 (2.81 - 12.73)	1.91 (0.72 - 3.36)
	Both	7.86 (3.30 - 13.46)	2.06 (0.85 - 3.56)	Both	7.19 (2.81 - 12.56)	1.89 (0.72 - 3.32)
Mild						
	Male	6.85 (2.34 - 12.81)	1.87 (0.61 - 3.56)	Male	6.35 (2.02 - 12.13)	1.73 (0.52 - 3.35)
	Female	6.99 (2.36 - 13.12)	1.91 (0.61 - 3.64)	Female	6.48 (2.04 - 12.40)	1.76 (0.52 - 3.42)
	Both	6.93 (2.35 - 12.98)	1.89 (0.61 - 3.60)	Both	6.42 (2.03 - 12.28)	1.75 (0.52 - 3.39)
Near						
	Both	45.27 (3.41 - 93.38)	39.59 (2.59 - 88.12)	Both	45.27 (3.40 - 93.37)	39.59 (2.59 - 88.11)

TABLE 3: Age-standardised prevalence of blindness and vision impairment (and 80% UI) by sex and region comparing adults 50 years and older with all ages in 2015

Ages 50+

	Men			Women			Both		
Region	**Blind**	**MSVI**	**Mild**	**Blind**	**MSVI**	**Mild**	**Blind**	**MSVI**	**Mild**
Caribbean	1.96 (0.68 - 3.56)	7.92 (3.32 - 13.60)	6.87 (2.33 - 13.05)	2.07 (0.69 - 3.80)	8.25 (3.29 - 14.37)	7.05 (2.33 - 13.44)	2.02 (0.07 - 3.69)	8.09 (3.30 - 14.00)	6.96 (2.32 - 13.2)
Andean	2.15 (0.73 - 3.97)	12.39 (5.87 - 20.46)	9.96 (3.80 - 17.88)	2.28 (0.77 - 4.25)	13.05 (6.04 - 21.64)	10.28 (3.87 - 18.42)	2.22 (0.08 - 4.12)	12.74 (5.96 - 21.09)	10.13 (3.83 - 18.16)
Central	1.79 (0.65 - 3.15)	8.47 (3.66 - 14.26)	7.35 (2.55 - 13.63)	1.85 (0.66 - 3.29)	8.67 (3.61 - 14.82)	7.48 (2.55 - 13.85)	1.82 (.066 - 3.23)	8.58 (3.63 - 14.56)	7.42 (2.56 - 13.74)
Southern	0.71 (0.31 - 1.22)	6.58 (3.12 - 11.01)	6.25 (2.25 - 11.70)	0.78 (0.34 - 1.34)	7.35 (3.52 - 12.28)	6.85 (2.51 - 12.73)	0.75 (0.32 - 1.29)	7.02 (3.36 - 11.73)	6.58 (2.40 - 12.27)
Tropical	1.40 (0.49 - 2.52)	6.30 (2.38 - 11.16)	5.83 (1.82 - 11.17)	1.42 (0.49 - 2.58)	6.35 (2.29 - 11.26)	5.85 (1.78 - 11.37)	1.41 (0.04 - 2.5)	6.33 (2.33 - 11.22)	5.84 (1.80 - 11.28)
World	1.82 (0.67 - 3.28)	10.12 (4.85 - 16.45)	8.33 (3.10 - 15.02)	1.91 (0.68 - 3.49)	10.79 (5.00 - 17.74)	8.77 (3.23 - 15.84)	1.87 (0.67 - 3.39)	10.47 (4.93 - 17.13)	8.56 (3.17 - 15.45)

All ages

	Men			Women			Both		
Region	**Blind**	**MSVI**	**Mild**	**Blind**	**MSVI**	**Mild**	**Blind**	**MSVI**	**Mild**
Caribbean	0.49 (0.17 - 0.89)	2.12 (0.86 - 3.68)	1.93 (0.61 - 3.73)	0.51 (0.17 - 0.94)	2.21 (0.85 - 3.89)	1.98 (0.61 - 3.84)	0.50 (0.17 - 0.92)	2.16 (0.86 - 2.79)	1.95 (0.61 - 3.78)
Andean	0.52 (0.18 - 0.97)	3.30 (1.51 - 5.52)	2.82 (1.00 - 5.22)	0.55 (0.19 - 1.04)	3.46 (1.55 - 5.83)	2.91 (1.01 - 5.38)	0.54 (0.18 - 1.00)	3.38 (0.15 - 5.68)	2.86 (1.00 - 5.30)
Central	0.44 (0.16 - 0.77)	2.22 (0.94 - 3.76)	2.00 (0.66 - 3.79)	0.45 (0.16 - 0.80)	2.27 (0.92 - 3.91)	2.04 (0.65 - 3.84)	0.45 (0.16 - 0.79)	2.24 (0.92 - 3.84)	2.02 (0.66 - 3.81)
Southern	0.17 (0.07 - 0.30)	1.71 (0.80 - 2.89)	1.67 (0.57 - 3.17)	0.19 (0.08 - 0.33)	1.91 (0.90 - 3.22)	1.83 (0.64 - 3.47)	0.18 (0.08 - 0.31)	1.82 (0.86 - 3.08)	1.75 (0.61 - 3.33)
Tropical	0.34 (0.12 - 0.61)	1.64 (0.61 - 2.92)	1.56 (0.47 - 3.03)	0.35 (0.12 - 0.63)	1.65 (0.58 - 2.94)	1.56 (0.45 - 3.06)	0.34 (0.12 - 0.62)	1.64 (0.59 - 2.93)	1.56 (0.46 - 3.04)
World	0.46 (0.17 - 0.84)	2.79 (1.29 - 4.61)	2.46 (0.84 - 4.55)	0.49 (0.17 - 0.90)	2.99 (1.33 - 4.99)	2.60 (0.88 - 4.85)	0.48 (0.17 - 0.87)	2.90 (1.31 - 4.80)	2.53 (0.86 4.70)

TABLE 4: Absolute numbers of persons affected by blindness and vision impairment in Latin American and the Caribbean in 2015 and projections to 2020

Region	Blind (millions)	MSVI (millions)	Mild (millions)	Near (millions)
2015				
Caribbean	0.22 (0.07 - 0.40)	0.90 (0.36 - 1.57)	0.80 (0.25 - 1.54)	6.56 (0.68 - 14.04)
Latin America, Andean	0.27 (0.09 - 0.51)	1.70 (0.77 - 2.86)	1.44 (0.50 - 2.67)	8.24 (0.87 - 17.68)
Latin America, Central	0.96 (0.34 - 1.70)	4.84 (2.00 - 8.29)	4.37 (1.40 - 8.28)	36.97 (3.65 - 79.79)
Latin America, Southern	0.17 (0.07 - 0.29)	1.53 (0.74 - 2.56)	1.43 (0.52 - 2.66)	3.28 (0.75 - 6.90)
Latin America, Tropical	0.72 (0.25 - 1.30)	3.49 (1.26 - 6.22)	3.33 (0.97 - 6.51)	36.67 (3.72 - 77.77)
Combined Total LAC	2.34 (0.82 - 4.20)	12.46 (5.13 - 21.5)	11.34 (3.64 - 21.66)	91.72 (9.67 - 196.18)
World	36.02 (12.86 - 65.44)	216.60 (98.51 - 359.07)	188.54 (64.46 - 350.19)	1094.75 (581.13 - 1686.54)
2020				
Caribbean	0.22 (0.07 - 0.41)	0.95 (0.35 - 1.69)	0.85 (0.25 - 1.66)	7.17 (0.75 - 15.29)
Latin America, Andean	0.28 (0.09 - 0.53)	1.84 (0.78 - 3.14)	1.56 (0.52 - 2.94)	9.46 (1.00 - 20.26)
Latin America, Central	1.00 (0.34 - 1.81)	5.27 (2.02 - 9.15)	4.78 (1.44 - 9.16)	42.56 (4.23 - 91.52)
Latin America, Southern	0.17 (0.07 - 0.30)	1.63 (0.75 - 2.78)	1.52 (0.53 - 2.86)	3.58 (0.82 - 7.55)
Latin America, Tropical	0.72 (0.23 - 1.35)	3.67 (1.23 - 6.68)	3.52 (0.95 - 7.02)	41.58 (4.21 - 88.20)
Combined Total LAC	2.39 (0.80 - 4.40)	13.36 (5.13 - 23.44)	12.23 (3.69 - 23.64)	104.35 (11.01 - 222.82)
World	38.50 (13.18 - 70.95)	237.08 (101.50 - 399.02)	205.73 (67.30 - 385.11)	1225.59 (653.43 - 1884.22)

TABLE 5: Proportion (%) of blindness, and moderate/severe vision impairment (MSVI) by cause in 1990, 2010, 2015 and projected to 2020 for all ages (80% Uncertainty Interval)

Region	Refractive Error		Cataract		Glaucoma		Macular Degeneration		Diabetic Retinopathy		Corneal Opacity		Other	
1990	Blind	MSVI	Blind	MSVI	Blind	MSVI	Blind	MSVI	Blind	MSVI	Blind	MSVI	Blind	MSVI
Caribbean	12.37 (10.48 - 14.21)	46.74 (42.23 - 50.32)	29.42 (23.42 - 35.36)	21.47 (16.96 - 26.14)	10.56 (4.07 - 18.89)	2.55 (0.84 - 4.89)	8.50 (2.26 - 17.34)	5.75 (1.35 - 12.07)	0.68 (0.13 - 1.47)	0.77 (0.15 - 1.60)	2.62 (0.26 - 6.37)	0.88 (0.08 - 2.03)	35.83 (18.24 - 52.15)	21.81 (8.56 - 35.80)
Andean	12.40 (10.50 - 14.26)	44.63 (38.93 - 49.12)	32.66 (26.42 - 38.79)	24.91 (19.98 - 29.97)	10.15 (3.84 - 18.29)	2.45 (0.81 - 4.76)	4.92 (1.00 - 10.71)	3.24 (0.59 - 7.17)	0.29 (0.05 - 0.61)	0.32 (0.05 - 0.66)	2.63 (0.27 - 6.44)	0.94 (0.09 - 2.16)	36.95 (18.84 - 53.71)	23.51 (9.29 - 38.45)
Central	12.39 (10.51 - 14.20)	46.39 (42.01 - 50.06)	30.15 (24.11 - 36.09)	22.34 (17.72 - 27.05)	10.46 (4.06 - 18.61)	2.51 (0.85 - 4.81)	7.19 (1.74 - 15.13)	4.70 (0.99 - 10.08)	0.53 (0.10 - 1.14)	0.58 (0.11 - 1.19)	2.65 (0.28 - 6.46)	0.90 (0.09 - 2.07)	36.63 (18.72 - 53.16)	22.59 (8.90 - 36.99)
Southern	12.91 (11.18 - 14.64)	47.75 (44.69 - 50.33)	27.07 (20.39 - 34.03)	20.63 (15.36 - 26.27)	14.00 (5.80 - 23.99)	3.74 (1.35 - 7.01)	15.72 (5.59 - 28.89)	10.98 (3.56 - 21.00)	2.08 (0.46 - 4.26)	2.16 (0.51 - 4.46)	3.39 (0.34 - 8.17)	1.19 (0.13 - 2.71)	24.83 (10.73 - 41.56)	13.55 (4.79 - 24.07)
Tropical	12.72 (10.91 - 14.47)	48.34 (44.91 - 51.06)	28.39 (22.62 - 34.18)	20.42 (16.14 - 24.87)	10.88 (4.29 - 19.26)	2.53 (0.86 - 4.82)	7.70 (1.89 - 16.08)	4.95 (1.07 - 10.59)	0.75 (0.15 - 1.63)	0.77 (0.15 - 1.58)	2.51 (0.27 - 6.01)	0.84 (0.09 - 1.92)	37.05 (18.93 - 53.77)	22.16 (8.76 - 36.23)
World	19.58 (17.29 - 21.72)	50.80 (46.12 - 54.74)	36.67 (30.11 - 43.22)	26.62 (21.53 - 31.78)	8.66 (3.25 - 15.72)	2.14 (0.69 - 4.11)	7.93 (2.32 - 15.54)	5.97 (1.63 - 11.87)	0.85 (0.15 - 1.83)	1.03 (0.20 - 2.22)	4.75 (0.80 - 10.47)	1.75 (0.25 - 3.81)	18.78 (7.12 - 32.87)	9.71 (3.03 - 18.50)
2010														
Caribbean	12.55 (10.73 - 14.33)	47.64 (44.17 - 50.48)	26.84 (20.18 - 33.56)	19.04 (14.26 - 24.00)	9.71 (3.56 - 17.58)	2.27 (0.73 - 4.27)	6.08 (1.47 - 12.60)	4.07 (0.91 - 8.68)	0.73 (0.14 - 1.55)	0.82 (0.17 - 1.71)	1.77 (0.18 - 4.22)	0.56 (0.06 - 1.32)	42.31 (21.64 - 61.34)	25.60 (10.06 - 41.96)
Andean	12.58 (10.77 - 14.37)	45.80 (41.40 - 49.37)	28.75 (21.97 - 35.58)	21.31 (16.21 - 26.59)	9.56 (3.59 - 17.13)	2.25 (0.76 - 4.17)	4.11 (0.89 - 8.66)	2.62 (0.54 - 5.63)	0.36 (0.06 - 0.75)	0.39 (0.08 - 0.81)	1.73 (0.18 - 4.14)	0.57 (0.07 - 1.31)	42.92 (21.86 - 62.44)	27.06 (10.62 - 44.39)
Central	12.66 (10.88 - 14.42)	47.67 (44.42 - 50.41)	25.21 (18.88 - 31.66)	18.07 (13.52 - 22.89)	10.12 (3.83 - 18.05)	2.37 (0.78 - 4.42)	6.48 (1.57 - 13.47)	4.16 (0.92 - 8.90)	0.83 (0.16 - 1.74)	0.89 (0.18 - 1.83)	1.73 (0.18 - 4.07)	0.55 (0.06 - 1.29)	42.97 (21.99 - 62.33)	26.28 (10.34 - 43.06)
Southern	12.98 (11.25 - 14.69)	48.06 (45.23 - 50.38)	23.12 (15.66 - 31.09)	17.20 (11.76 - 23.22)	13.76 (5.13 - 24.60)	3.72 (1.20 - 7.16)	14.49 (4.43 - 28.05)	10.23 (3.11 - 20.00)	2.97 (0.50 - 6.58)	3.30 (0.58 - 7.27)	2.52 (0.22 - 6.04)	0.86 (0.09 - 2.05)	30.17 (13.06 - 50.33)	16.64 (5.86 - 29.57)
Tropical	12.88 (11.13 - 14.60)	49.17 (46.60 - 51.28)	22.99 (17.07 - 29.13)	16.13 (11.94 - 20.60)	10.62 (4.03 - 18.95)	2.44 (0.79 - 4.59)	7.79 (1.92 - 16.12)	4.94 (1.11 - 10.61)	1.26 (0.25 - 2.65)	1.30 (0.27 - 2.67)	1.64 (0.17 - 3.83)	0.52 (0.06 - 1.22)	42.80 (21.80 - 62.28)	25.50 (10.01 - 41.85)
World	20.23 (18.16 - 22.20)	52.12 (48.44 - 55.23)	35.67 (27.74 - 43.66)	25.55 (19.80 - 31.54)	8.48 (3.17 - 15.38)	2.04 (0.66 - 3.93)	6.28 (1.68 - 12.64)	4.65 (1.21 - 9.53)	0.99 (0.16 - 2.19)	1.21 (0.21 - 2.68)	3.37 (0.58 - 7.39)	1.19 (0.19 - 2.55)	23.43 (8.98 - 40.83)	12.17 (3.87 - 23.03)
2015														
Caribbean	12.59 (10.78 - 14.37)	47.85 (44.44 - 50.66)	25.74 (18.66 - 32.95)	18.09 (13.08 - 23.36)	9.61 (3.32 - 17.76)	2.25 (0.68 - 4.30)	5.64 (1.25 - 11.90)	3.76 (0.78 - 8.16)	0.79 (0.13 - 1.70)	0.89 (0.16 - 1.90)	1.65 (0.15 - 3.91)	0.52 (0.05 - 1.23)	43.98 (22.57 - 63.65)	26.64 (10.50 - 43.58)
Andean	12.62 (10.82 - 14.41)	46.07 (41.71 - 49.60)	27.48 (20.20 - 34.81)	20.23 (14.87 - 25.82)	9.40 (3.33 - 17.26)	2.22 (0.70 - 4.16)	3.84 (0.78 - 8.18)	2.44 (0.47 - 5.27)	0.39 (0.06 - 0.83)	0.42 (0.07 - 0.89)	1.60 (0.16 - 3.82)	0.53 (0.06 - 1.22)	44.66 (22.83 - 64.82)	28.09 (11.05 - 46.03)
Central	12.71 (10.93 - 14.46)	47.90 (44.70 - 50.60)	23.97 (17.25 - 30.90)	17.03 (12.25 - 22.14)	9.99 (3.56 - 18.25)	2.34 (0.72 - 4.46)	6.19 (1.38 - 13.07)	3.96 (0.82 - 8.60)	0.95 (0.16 - 2.03)	1.02 (0.19 - 2.14)	1.62 (0.16 - 3.83)	0.52 (0.05 - 1.21)	44.58 (22.85 - 64.57)	27.23 (10.72 - 44.58)
Southern	13.00 (11.27 - 14.71)	48.20 (45.38 - 50.51)	21.68 (13.89 - 30.16)	15.95 (10.40 - 22.13)	13.61 (4.67 - 25.00)	3.71 (1.09 - 7.35)	14.34 (3.98 - 28.60)	10.11 (2.78 - 20.18)	3.51 (0.51 - 8.08)	3.93 (0.60 - 8.97)	2.41 (0.19 - 5.85)	0.82 (0.07 - 1.96)	31.45 (13.62 - 52.38)	17.28 (6.09 - 30.72)
Tropical	12.90 (11.14 - 14.62)	49.26 (46.68 - 51.36)	21.88 (15.57 - 28.47)	15.27 (10.84 - 20.04)	10.45 (3.72 - 19.07)	2.41 (0.73 - 4.62)	7.39 (1.68 - 15.61)	4.68 (0.98 - 10.20)	1.33 (0.24 - 2.87)	1.38 (0.26 - 2.90)	1.54 (0.15 - 3.60)	0.49 (0.05 - 1.14)	44.50 (22.78 - 64.56)	26.52 (10.43 - 43.45)
World	20.28 (18.23 - 22.24)	52.34 (48.66 - 55.45)	35.15 (26.40 - 44.03)	25.15 (18.83 - 31.76)	8.49 (2.99 - 15.66)	2.05 (0.62 - 4.03)	5.93 (1.46 - 12.18)	4.38 (1.05 - 9.15)	1.06 (0.15 - 2.38)	1.30 (0.20 - 2.93)	3.21 (0.50 - 7.19)	1.14 (0.17 - 2.48)	24.92 (9.58 - 43.36)	13.00 (4.14 - 24.57)
2020														
Caribbean	12.64 (10.83 - 14.42)	48.08 (44.72 - 50.89)	24.41 (16.89 - 32.10)	16.96 (11.69 - 22.60)	9.52 (3.02 - 18.11)	2.24 (0.62 - 4.43)	5.61 (1.13 - 12.13)	3.79 (0.71 - 8.44)	0.98 (0.14 - 2.15)	1.13 (0.18 - 2.43)	1.55 (0.13 - 3.68)	0.49 (0.04 - 1.16)	45.29 (23.19 - 65.61)	27.31 (10.73 - 44.77)
Andean	12.68 (10.88 - 14.47)	46.44 (42.08 - 49.95)	25.88 (18.18 - 33.74)	18.85 (13.21 - 24.79)	9.37 (3.09 - 17.57)	2.22 (0.66 - 4.31)	3.84 (0.72 - 8.30)	2.45 (0.44 - 5.40)	0.47 (0.07 - 1.03)	0.52 (0.08 - 1.11)	1.52 (0.14 - 3.64)	0.49 (0.05 - 1.17)	46.23 (23.66 - 67.02)	29.01 (11.41 - 47.55)
Central	12.77 (10.99 - 14.52)	48.19 (45.06 - 50.85)	22.21 (15.17 - 29.53)	15.62 (10.65 - 21.01)	9.98 (3.27 - 18.77)	2.36 (0.66 - 4.65)	6.26 (1.27 - 13.53)	4.02 (0.75 - 8.98)	1.18 (0.18 - 2.59)	1.28 (0.20 - 2.74)	1.53 (0.13 - 3.60)	0.48 (0.04 - 1.14)	46.07 (23.64 - 66.64)	28.04 (11.04 - 45.90)
Southern	13.02 (11.28 - 14.73)	48.31 (45.43 - 50.65)	20.52 (12.46 - 29.48)	14.90 (9.24 - 21.30)	13.56 (4.21 - 25.70)	3.74 (0.99 - 7.70)	13.83 (3.41 - 28.54)	9.81 (2.36 - 20.20)	3.98 (0.49 - 9.37)	4.51 (0.57 - 10.61)	2.33 (0.16 - 5.75)	0.80 (0.06 - 1.93)	32.75 (14.20 - 54.46)	17.93 (6.32 - 31.88)
Tropical	12.95 (11.20 - 14.67)	49.49 (47.01 - 51.54)	19.63 (13.13 - 26.46)	13.52 (9.03 - 18.47)	10.53 (3.41 - 19.89)	2.46 (0.67 - 4.89)	8.24 (1.70 - 17.74)	5.25 (0.98 - 11.81)	1.93 (0.30 - 4.27)	2.03 (0.33 - 4.43)	1.47 (0.12 - 3.44)	0.46 (0.04 - 1.08)	45.24 (23.07 - 65.74)	26.79 (10.49 - 44.00)
World	20.58 (18.52 - 22.54)	52.61 (48.86 - 55.76)	34.73 (25.04 - 44.63)	24.75 (17.77 - 32.12)	8.43 (2.75 - 15.96)	2.05 (0.57 - 4.15)	5.57 (1.23 - 11.72)	4.16 (0.89 - 8.94)	1.20 (0.16 - 2.75)	1.49 (0.20 - 3.43)	3.09 (0.42 - 7.09)	1.10 (0.14 - 2.45)	25.99 (9.96 - 45.27)	13.61 (4.34 - 25.73)